MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

SUPPLEMENTARY EXAMINATION

TRIMESTER 1, 2015/2016

PPP0101 – PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

18 NOV 2015
9.00 AM – 11.00 AM
(2 HOURS)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 printed pages excluding the cover page. physical constants and formula list.
2. Attempt **ALL** questions. The distribution of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

ANSWER ALL QUESTIONS

QUESTION 1 (8 MARKS)

a) Find the resultant of the three displacement vectors as shown in **Figure Q1(a)** by means of the component method. The magnitudes of the vectors are A = 3.00 m, B = 4.00 m, and C = 5.00 m.

[5 marks]

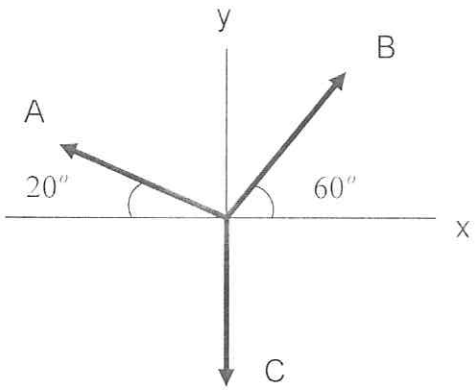

Figure Q1(a)

b) The density ρ of a cylinder is given by $\rho = \frac{4m}{\pi d^2 h}$ where d, h and m are the diameter, height and mass of the cylinder respectively.

(i) Show that the equation is dimensionally correct.

[2 marks]

(ii) State the SI unit of density.

[1 mark]

QUESTION 2 (8 MARKS)

a) A cyclist rides along a straight road from a point A to a point B. He starts from rest at A and accelerates uniformly to reach a speed of 12 m/s in 8 seconds. He maintains this speed for a further 20 seconds and then uniformly decelerates to rest at B. If the whole journey takes 34 seconds,

(i) draw a velocity-time graph for the motion.

[3 marks]

(ii) Find his acceleration during the first 8 seconds.

[1 mark]

(iii) Calculate the total distance traveled.

[2 marks]

Continued...

b) A stone is dropped vertically from the top of an overhanging cliff, and it hits the sea 3 seconds later. Calculate

(i) the speed of the stone when it hits the sea, and

[1 mark]

(ii) the height of the cliff.

[1 mark]

QUESTION 3 (8 MARKS)

Three blocks in **Figure Q3** are made to move on a rough surface by a 32.0 N external force. The coefficient of kinetic friction of the rough surface is 0.1.

a) Draw a free-body-diagram (*FBD*) for each block (total of *3 FBDs*).

[3 marks]

b) Determine the acceleration, a, of the system (the three blocks).

[3 marks]

c) Find the tension in the cord connecting the 4.0 kg and the 5.0 kg blocks.

[2 marks]

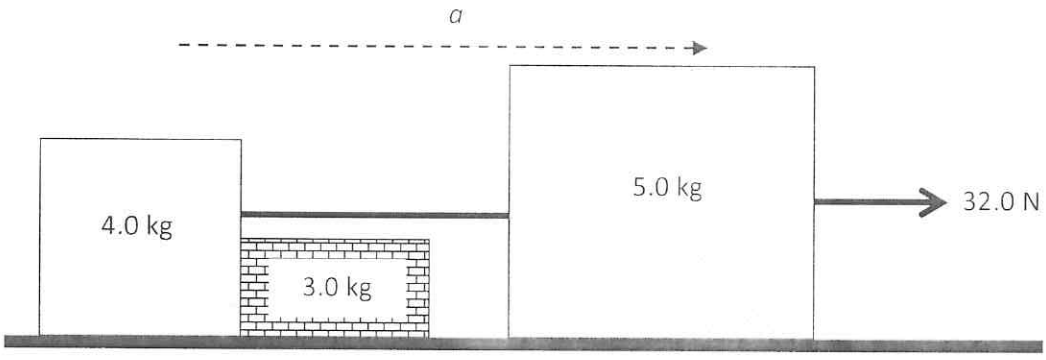

Figure Q3

Continued...

QUESTION 4 (8 MARKS)

The position of an object attached to a spring is described by

$$x(t) = (0.330m)\cos(1.50t)$$

Find

a) the amplitude, [0.5 mark]

b) the angular frequency, [0.5 mark]

c) the frequency, [1 mark]

d) the period [1 mark]

e) the magnitudes of the maximum velocity and maximum acceleration, [2 marks]

f) the position, velocity and acceleration when $t = 0.25$ s. [3 marks]

QUESTION 5 (8 MARKS)

a) Distinguish the difference between Mechanical Waves and Electromagnetic Waves. [1 mark]

b) Audio system 1 produces an intensity level of $\beta_1 = 80.0$ dB, and system 2 produces an intensity level of $\beta_2 = 83.0$ dB. The corresponding intensities (in W/m^2) are I_1 and I_2. Determine the ratio I_2/I_1. [3 marks]

c) A high speed train is travelling at a speed of 54.7 m/s when the engineer sounds the 515 Hz warning horn. The speed of sound is 343 m/s. What are the frequencies and the wavelengths of the sound, as perceived by a person standing at a crossing, when the train is

(i) approaching and [2 marks]

(ii) leaving the crossing? [2 marks]

Continued...

QUESTION 6 (10 MARKS)

a) A pair of narrow, parallel slits separated by 8.00 μm is illuminated by the green component from a mercury vapor lamp (λ = 553 nm). The interference pattern is observed on a screen 1.20 m from the plane of the parallel slits. Calculate the

(i) distance from the central maximum to the first bright region on either side of the central maximum.

[1 mark]

(ii) distance between the first and second dark bands in the interference pattern, and

[1 mark]

(iii) number of dark fringes will be produced on either side of the central maximum.

[2 marks]

b) Calculate the angles θ_1, θ_2, θ_3, and θ_4 in **Figure Q6(b)** below.

[4 marks]

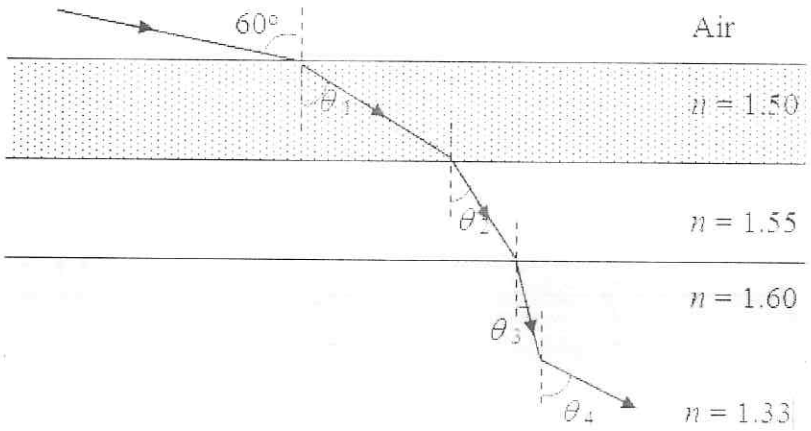

Figure Q6(b)

c) A diffraction grating has 11000 lines/cm. A beam of light of wavelength 420 nm is incident normally on the grating. Determine the angular position of the second order maxima.

[2 marks]

End of paper.

APPENDIX

LIST OF PHYSICAL CONSTANTS

Electron mass,	m_e	=	9.11×10^{-31} kg
Proton mass,	m_p	=	1.67×10^{-27} kg
Neutron mass,	m_n	=	1.67×10^{-27} kg
Magnitude of the electron charge,	e	=	1.602×10^{-19} C
Universal gravitational constant,	G	=	6.67×10^{-11} N.m^2 kg^{-2}
Universal gas constant,	R	=	8.314 J/K.mol
Hydrogen ground state,	E_o	=	13.6 eV
Boltzmann's constant,	k_B	=	1.38×10^{-23} J/K
Compton wavelength,	λ_c	=	2.426×10^{-12} m
Planck's constant,	h	=	6.63×10^{-34} J.s
		=	4.14×10^{-15} eV.s
Speed of light in vacuum,	c	=	3.0×10^8 m/s
Rydberg constant,	R_H	=	1.097×10^7 m^{-1}
Acceleration due to gravity,	g	=	9.80 m s^{-2}
1 unified atomic mass unit,	1 u	=	931.5 MeV/c^2
		=	1.66×10^{-27} kg
1 electron volt,	1 eV	=	1.60×10^{-19} J
Avogadro's number,	N_A	=	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing,	I_o	=	1.0×10^{-12} W m^{-2}
Coulomb constant,	$k = \frac{1}{4\pi\varepsilon_o}$	=	9.0×10^9 Nm^2 C^{-2}
Permittivity of free space,	ε_o	=	8.85×10^{-12} C^2/N.m^{-2}
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ (T.m)/A
1 atmosphere pressure,	1 atm	=	1.0×10^5 N/m^2
			1.0×10^5 Pa
Earth: Mass,	M_E	=	5.97×10^{24} kg
Radius (mean),	R_E	=	6.38×10^3 km
Moon: Mass,	M_M	=	7.35×10^{22} kg
Radius (mean),	R_M	=	1.74×10^3 km
Sun: Mass,	M_S	=	1.99×10^{30} kg
Radius (mean),	R_S	=	6.96×10^5 km
Earth-Sun distance (mean),		=	149.6×10^6 km
Earth-Moon distance (mean),		=	384×10^3 km

LIST OF FORMULA

Differential Rule

$$y = kx^n$$

$$\frac{dy}{dx} = knx^{n-1}$$

Trigonometric Identity

$$\sin = \frac{opposite}{hypotenuse} \qquad \cos = \frac{adjacent}{hypotenuse} \qquad \tan = \frac{opposite}{adjacent}$$

$$\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$$

$$\sin(\alpha-\beta) + \sin(\alpha+\beta) = 2\sin\alpha\cos\beta$$

NEWTONIAN MECHANICS

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad v = v_o + at \qquad x - x_o = v_o t + \frac{1}{2}at^2$$

$$v^2 = v_o^2 + 2a(x - x_o) \qquad x - x_o = \left(\frac{v_o + v}{2}\right)t$$

$$v = v_o + gt \qquad y - y_o = v_o t + \frac{1}{2}gt^2 \qquad v^2 = v_o^2 + 2g(y - y_o) \qquad y - y_o = \left(\frac{v_o + v}{2}\right)t$$

$$W = Fs\cos\theta \qquad W = mg \qquad \sum F = F_{net} = ma \qquad f_s \le \mu_S F_N$$

$$f_k = \mu_K F_N \qquad p = mv \qquad \sum F = \frac{\Delta p}{\Delta t}$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad m_1u_1 + m_2u_2 = (m_1 + m_2)\,v \qquad P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v}$$

$$K = \frac{1}{2}mv^2 \qquad PE_s = \frac{1}{2}kx^2 \qquad F_s = -kx \qquad PE_G = mgy$$

$$v_{circular} = \frac{2\pi r}{T} \qquad a_c = \frac{v^2}{r} \qquad F_g = G\frac{m_1m_2}{r^2} \qquad U_g = -G\frac{m_1m_2}{r}$$

$$T^2 = K_s r^3 \qquad T_s = 2\pi\sqrt{\frac{m}{k}}$$

Spring with mass, Simple pendulum,

$$\omega = \sqrt{\frac{k}{m}} \qquad \omega = \sqrt{\frac{g}{l}} \qquad T_p = 2\pi\sqrt{\frac{l}{g}} \qquad T = \frac{2\pi}{\omega} = \frac{1}{f}$$

	$x = A\cos\omega t$		$x = A\sin\omega t$
Cosine Wave:	$v = -\omega A\sin\omega t$	Sine Wave:	$v = \omega A\cos\omega t$
	$a = -\omega^2 A\cos\omega t$		$a = -\omega^2 A\sin\omega t$

WAVES AND OPTICS

$v = f\lambda$ $\omega = 2\pi f$ $n = \frac{c}{v}$ $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_c = \frac{n_2}{n_1}$ $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$ $M = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$ $f = \frac{R}{2}$

$d\sin\theta_{max} = m\lambda$ $a\sin\theta_{min} = m\lambda$ $d\sin\theta_{min} = (m + \frac{1}{2})\lambda$

$y_{bright} = \frac{m\lambda L}{d}$ $y_{dark} = (m + \frac{1}{2})\frac{\lambda L}{d}$ $I = \frac{P}{A}$ $\beta = 10\log_{10}\frac{I}{I_o}$

$f' = f\left(\frac{v \pm v_o}{v \mp v_s}\right)$ $y(x,t) = A\sin(kx \pm \omega t + \phi)$

Wave Type:

$y(x,t) = 2A\cos\left(\frac{\phi}{2}\right)\sin(kx - \omega t - \frac{\phi}{2})$

$y(x,t) = 2A\sin kx\cos\omega t$